1991

A SOCIAL COGNITIVE THEORY PERSPECTIVE ON INDIVIDUAL REACTIONS TO COMPUTING TECHNOLOGY

Deborah R. Compeau
The University of Western Ontario, dcompeau@ivey.uwo.ca

Christopher A. Higgins
The University of Western Ontario

A SOCIAL COGNITIVE THEORY PERSPECTIVE ON INDIVIDUAL REACTIONS TO COMPUTING TECHNOLOGY

Deborah R. Compeau
Christopher A. Higgins
School of Business Administration
The University of Western Ontario

ABSTRACT

Understanding individual reactions to computing technology is a central concern of information systems research. This research seeks to understand these reactions from the perspective of Social Cognitive Theory (Bandura 1977, 1978, 1982, 1986), a widely accepted theory of behavior in Social Psychology and Industrial/Organizational Psychology. The theory holds that behavior, environment, and cognitive and other individual factors are engaged in an ongoing reciprocal interaction. Two cognitive factors in particular are given prominence in the theory: (1) outcome expectations, or beliefs about the consequences of behavior and (2) self-efficacy, beliefs about one's ability to successfully execute particular behaviors. A model of individual reactions to computing technology based on this theory was tested on a sample of 940 Canadian knowledge workers. Eleven of the fourteen hypotheses were supported by the analysis. Key findings were that self-efficacy, outcome expectations, affect and anxiety all had a direct influence on computer use. In addition, outcome expectations and self-efficacy were found to indirectly influence computer use through affect and anxiety. The behavior and influence of others in the individuals' reference groups was found to exert a small influence on self-efficacy and outcome expectations.

1. INTRODUCTION

Information systems research has devoted a great deal of attention to the study of individual reactions to computing technology. This research, however, has reflected a limited theoretical perspective and has overlooked or underutilized important theories from other disciplines. Social Cognitive Theory (Bandura 1977, 1978, 1982, 1986) is a widely accepted and empirically validated theory of individual behavior which encompasses most of the important concepts in organizational behavior (Davis and Luthans 1980). However, in spite of its widespread acceptance in Social Psychology and Industrial/Organizational Psychology, this theory has been virtually ignored in information systems research.

Social Cognitive Theory is based on the premise that environmental influences, such as social pressures or unique situational characteristics, cognitive and other personal factors, including personality as well as demographic characteristics, and behavior are reciprocally determined. Thus, individuals choose the environments in which they exist, in addition to being influenced by those environments. Furthermore, behavior in a given situation is affected by environmental or situational characteristics, which are in turn affected by behavior. Finally, behavior is influenced by cognitive and personal factors and, in turn, affects those same factors. This relationship, which Bandura refers to as "triadic reciprocality," is shown in Figure 1.

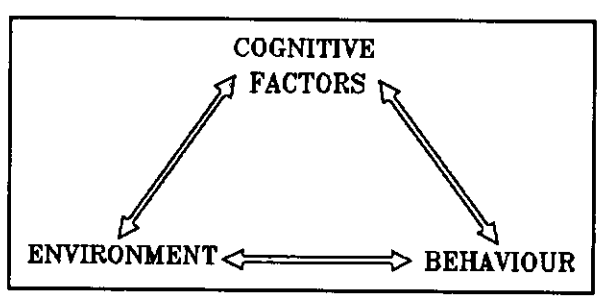


Figure 1. Social Cognitive Theory - Triadic Reciprocality

Social Cognitive Theory advances two sets of expectations as the major cognitive forces guiding behavior. The first set of expectations relate to outcomes. Individuals are more likely to undertake behaviors they believe will result in valued outcomes than those which they do not expect to have favorable consequences. The second set of expectations encompasses what Bandura calls "self-efficacy," or beliefs about one's ability to perform a particular behavior. Bandura (1977, p. 193) argued that self-efficacy, in addition to outcome expectations, must be considered, since

individuals can believe that a particular course of action will produce certain outcomes, but if they entertain serious doubts about whether they can perform the necessary activities such information does not influence their behavior.

Outcome expectations have been considered by many IS researchers. The usefulness construct measured by Davis (1989) and Davis, Bagozzi and Warshaw (1989) reflects beliefs (or expectations) about outcomes, as does the salient beliefs construct used by Davis, Bagozzi and Warshaw. Thompson, Higgins and Howell (1991) tested a model of PC use based on Triandis (1980), which included perceived consequences as a central determinant of behavior. Questions measuring attitudes, such as those used by Robey (1979) also reflect outcome expectations.

Self-efficacy, on the other hand, has received much less attention in IS research. Webster and Martocchio (1990) found that self-efficacy perceptions were related to performance in a computer training course. Davis and Davis, Bagozzi and Warshaw suggested self-efficacy perceptions as a rationale for the influence of ease of use on behavior. Only the Webster and Martocchio study, however, explicitly measured self-efficacy.

Social psychologists have shown more interest than IS researchers in the role of self-efficacy in the adoption and use of computer technologies. Burkhardt and Brass (1990) found that self-efficacy was related to the early adoption of computer technologies. Hill, Smith and Mann (1986) demonstrated a relationship between self-efficacy and perceptions about computing technology. A second study by the same authors (Hill, Smith and Mann 1987) found that self-efficacy perceptions predicted enrolment in a computer course. Gist, Schwoerer and Rosen (1989) demonstrated the importance of self-efficacy as a predictor of training performance for a Lotus 1-2-3 course.

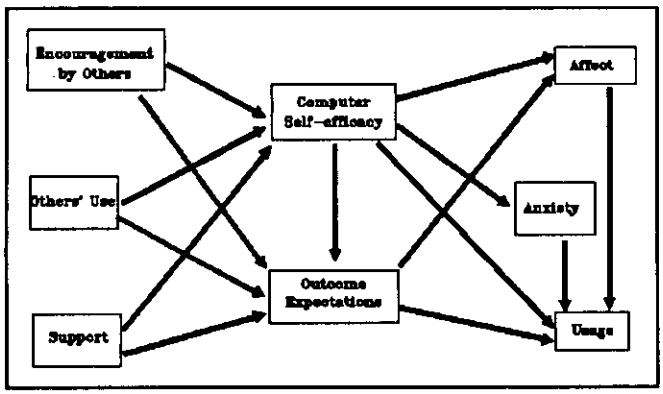


Figure 2. Research Model

Consideration of the Social Cognitive Theory perspective, in particular the role of self-efficacy in the adoption and use of computing technologies, may yield new insights into individuals' computing behavior. Accordingly, the purpose of this research is to investigate a model of computer usage based on Social Cognitive Theory. This research model is shown in Figure 2.

2. RESEARCH MODEL AND HYPOTHESES

The premise of triadic reciprocality, which separates Bandura's theory from most other motivational theories, can be fully investigated only through longitudinal research. However, it is possible to examine a sub-model (such as Figure 2) to gain at least a preliminary understanding of the relationships at work. While this research model does not test the reciprocal influences, it provides a reasonable explanation of the forces influencing computer usage. Figure 2 indicates that outcome expectations and self-efficacy are the two primary cognitive forces guiding computer usage. In other words, individuals' beliefs about the likely consequences of their actions and their judgements of their capability to execute those actions are important determinants of behavior choice. Emotional responses, such as affect and anxiety, are also viewed as influences on behavior, and are also considered to be a function of judgements about self-efficacy and outcome expectations.

Judgements of self-efficacy and outcome expectations are influenced by many factors, including prior experience with the behavior and environmental characteristics, but Social Cognitive Theory attaches particular importance to the role of observational learning. Encouragement by others, others' actual use, and organizational support are all components of observational learning. Thus, all three are considered important determinants of self-efficacy and outcome expectations. These relationships, which form the hypotheses of the present study, are discussed below.

2.1 Encouragement by Others

The encouragement of others within the individual's reference group can be expected to influence both self-efficacy and outcome expectations. Encouragement of use represents "verbal persuasion," one of the four major sources of efficacy information (Bandura 1986). Individuals rely, in part, on the opinions of others in forming judgements about their own abilities. Thus, encouragement from others influences self-efficacy, if the source of encouragement is perceived as credible (Bandura 1986). The related hypothesis is:

H1. The higher the encouragement of use by members of the individual's reference group, the higher the individual's self-efficacy.

Encouragement of use may also exert an influence on outcome expectations. If others in the reference group, particularly those in the individual's work organization, encourage the use of computing technology, the individual's judgements about the likely consequences of the behavior will be affected. At the very least, the individual will expect that his or her coworkers will be pleased by the behavior. Thus, the second hypothesis of the research is:

H2. The higher the encouragement of use by members of the individual's reference group, the higher the individual's outcome expectations.

2.2 Others' Use

Encouragement of use is one source of influence on self-efficacy and outcome expectations. The actual behavior of others with respect to the technology is a further source of information used in forming self-efficacy and outcome expectations. Learning by observation, or behavior modeling, has been shown to be a powerful means of behavior acquisition (Latham and Saari 1979; Manz and Sims 1986; Schunk 1981). Behavior modeling influences behavior in part through its influence on self-efficacy (Bandura, Adams and Beyer 1977) and also through its influence on outcome expectations, by demonstrating the likely consequences of the behavior (Bandura 1971). Thus, hypotheses 3 and 4 reflect the influence of the modeling behavior of others in the individual's reference group:

H3. The higher the use of the technology by others in the individual's reference group, the higher the individual's self-efficacy.

H4. The higher the use of the technology by others in the individual's reference group, the higher the individual's outcome expectations.

2.3 Support

The support of the organization for computer users can also be expected to influence individuals' judgements of self-efficacy. The availability of assistance to individuals who require it should increase their ability, and thus their perceptions of their ability. Support can also be expected to influence outcome expectations, as it reflects the formal stance of the organization towards the behavior, and thus may provide clues about the likely consequences of using the computer. Thus, hypotheses 5 and 6 are as follows:

H5. The higher the support for computer users in the organization, the higher the individual's self-efficacy.

H6. The higher the support for computer users in the organization, the higher the individual's outcome expectations.

2.4 Computer Self-efficacy

Social Cognitive Theory affords a prominent role to self-efficacy perceptions. Self-efficacy judgements are purported to influence outcome expectations since "the outcomes one expects derive largely from judgements as to how well one can execute the requisite behavior" (Bandura 1978, p. 241). The hypothesis is:

H7. The higher the individual's self-efficacy, the higher his/her outcome expectations.

Self-efficacy judgements are also held to have a substantial influence on the emotional responses of the individual. Individuals will tend to prefer and enjoy behaviors they feel they are capable of performing and to dislike those they do not feel they can successfully master. Several studies in psychology provide support for this contention. Betz and Hackett (1981) found that self-efficacy perceptions were significantly related to affect (or interest) for particular occupations. Bandura, Adams and Beyer (1977) and Stumpf, Brief and Hartman (1987) found that individuals experience anxiety in attempting to perform behaviors they do not feel competent to perform. These relationships are predicted by hypotheses 8 and 9, as follows:

H8. The higher the individual's self-efficacy, the higher his/her affect (or liking) of computer use.

H9. The higher the individual's self-efficacy, the lower his/her computer anxiety.

Finally, self-efficacy perceptions are predicted to be a significant precursor to computer use. This hypothesis is supported by research regarding computer use (Burkhardt and Brass 1990; Hill, Smith and Mann 1987) and research in a variety of other domains (Bandura, Adams and Beyer 1977; Betz and Hackett 1981; Frayne and Latham 1987). It is stated as follows:

H10. The higher the individual's self-efficacy, the higher his/her use of computers.

2.5 Outcome Expectations

Outcome expectations also exert a significant influence on individuals' reactions to computing technology. First, the expected consequences of a behavior may exert an influence on affect (or liking) for the behavior, through a process of association. That is, the satisfaction derived from the favorable consequences of the behavior becomes linked to the behavior itself, causing an increased affect for the behavior (Bandura 1986). This gives rise to the following hypothesis:

H11. The higher the individual's outcome expectations, the higher his/her affect (or liking) for the behavior.

Outcome expectations are also an important precursor to usage behavior. According to Social Cognitive Theory, individuals are more likely to engage in behavior they expect will be rewarded (or will result in favorable consequences). Bandura (1971) found support for this contention in a study of aggressive behavior in children. The hypothesis is also supported by research on computer use (Davis, Bagozzi and Warshaw 1989; Hill, Smith and Mann 1987; Pavri 1988; Thompson, Higgins and Howell 1991). Thus, the hypothesis is:

H12. The higher the individual's outcome expectations, the higher his/her use of computers.

2.6 Affect

Individuals' affect (or liking) for particular behaviors can, under some circumstances, exert a strong influence on their actions. Television preferences, for example, are almost solely based on affect (Bandura 1986). Consumer choices are also often made on the basis of affective reactions (Engle, Blackwell and Miniard 1986).

These examples, however, reflect activities for which individual discretion is high. Computer use, depending on the environmental context, may or may not be a discretionary activity. If use is mandated by individuals' jobs, then affect may exert little influence on use. In any event, the relationship between an individual's liking for computer use and his or her actual behavior is worthy of further study. Thus, the next hypothesis is:

H13. The higher the individual's affect for computer use, the higher his/her use of computers.

2.7 Anxiety

Feelings of anxiety surrounding computers are expected to negatively influence computer use. Not surprisingly, people are expected to avoid behaviors which invoke anxious feelings. A number of studies have demonstrated a relationship between computer anxiety and the use of computers (e.g., Igbaria, Pavri and Huff 1989; Webster, Heian and Michelman 1990). Thus, the final hypothesis of the study is:

H14. The higher the individual's computer anxiety, the lower his/her use of computers.

3. RESEARCH DESIGN

3.1 Measures

Encouragement by Others. The extent to which use of computers was encouraged by others in the individual's reference group was measured by seven items. Respondents were asked to assess, on a five point scale, the extent to which their use of computers was encouraged by their peers in their work organization, their peers in other organizations, their family, their friends, their manager, other management, and their subordinates.

Others' Use. The extent to which computers were actually used by others in the individual's reference group was also assessed using seven items. Respondents were asked to indicate, on a five point scale, the extent to which their peers in their work organization, their peers in other organizations, their family, their friends, their manager, other management, and their subordinates actually used computers.

Support. The organizational support for computer users was measured by six items, drawn from Thompson, Higgins and Howell (1991). The respondents were asked to indicate, on a five point scale, the extent to which assistance was available in terms of equipment selection, hardware difficulties, software difficulties, and specialized instruction. They also rated (on the same scale) the extent to which their coworkers were a source of assistance in overcoming difficulties and their perception of the organization's overall support for computer users.

Self-efficacy. Self-efficacy was measured by ten items which asked the respondents to rate their expected ability to accomplish a task using an unfamiliar software package with different levels of assistance. For example, the respondents were asked whether they could accomplish the task using the computer "if no one was around to tell them what to do as they went" or "if they had a lot of time to complete the job." This measure was developed based on an extensive review of the literature on self-efficacy (Compeau and Higgins 1991). The use of an unfamiliar software package was chosen as the focus for the measure based on discussions with computer users

and IS professionals. These discussions suggested that the factor which truly separated confident from non-confident users (or those with high versus low self-efficacy) was not the ability to accomplish a specific range of tasks, but the ability to deal with unfamiliar situations. Whereas users with sufficient experience might be able to accomplish a specific range of tasks quite easily, only those with high confidence could readily adapt to the unfamiliar.

Outcome Expectations. An eleven-item measure of outcome expectations was developed based on a review of existing measures in the IS literature. For example, Davis' (1989) measure of usefulness deals primarily with outcome expectations. Similarly, Pavri's (1988) beliefs construct, and three of Thompson, Higgins and Howell's (1991) constructs, reflect the expected consequences of using a computer. The measure presented a variety of outcomes which might be associated with computer use, including increased productivity, decreased reliance on clerical support, enhanced quality of work output, feelings of accomplishment, and enhanced status. Respondents were asked to indicate, on a five point scale, how likely they thought it was that each of these outcomes would result from their use of computers.

Affect. Affect was measured in this study by five items, drawn from the Computer Attitude Scale (Loyd and Gressard 1984). Respondents indicated, on a five point scale, the extent to which they agreed or disagreed with items such as "I like working with computers," and "Once I get working on the computer, I find it hard to stop."

Anxiety. Anxiety was measured by the nineteen-item Computer Anxiety Rating Scale (Heinssen, Glass and Knight 1987). Webster, Heian and Michelman (1990) found this to be a valid scale for measuring computer anxiety. Respondents indicated, on a five point scale, the extent to which they agreed or disagreed with statements such as "I feel apprehensive about using computers."

Use. Computer use was measured by four items, reflecting the duration and frequency of use of computers at work, and the duration of use of computers at home on weekdays and weekends.

3.2 Sample

The target population for the study was knowledge workers, individuals whose work requires them to process large amounts of information. This category includes most managers, as well as professionals such as insurance adjusters, financial analysts, researchers, consultants and accountants. The subscriber list of a Canadian business periodical was obtained as a sampling frame to reach this population.

3.3 Procedures

Pretest. A pretest of the questionnaire was conducted with forty people, including both academics and practitioners. Each of the respondents completed the questionnaire and provided feedback about the process and the measures. Overall, they indicated that the questionnaire was relatively clear and easy to complete. Following the pretest, a number of modifications to the instrument were made, in order to improve the measures and the overall structure of the questionnaire.

Pilot study. One hundred people within a limited geographical area were randomly selected from the subscriber list for the pilot study. The geographical restriction was placed on the sample so that follow up interviews could be conducted with as many of the respondents as possible. The survey was mailed to selected individuals with a cover letter indicating the purpose and importance of the study. A follow up letter was sent to those individuals who had not responded after two weeks.

The pilot study served a number of purposes. First, it provided an opportunity to obtain feedback about the questionnaire from members of the target population. In addition, the data collected in the pilot study were used to make a preliminary assessment of the reliability and validity of the measures. Finally, the pilot study data were used to calculate the expected response rate, required sample size, and thus the appropriate size of the mailing for the main study.

Sixty-four responses were received from the one hundred questionnaires mailed. Analysis of these responses indicated that the measures were reliable and related in a manner consistent with the predictions of Social Cognitive Theory. The pilot study analysis, and interviews with several of the respondents, also indicated the need for additional information. The Others' Use and Organizational Support constructs were added following the pilot study to provide additional information about the formation of self-efficacy and outcome expectations.

Main study. The procedures for the main study mirrored those used in the pilot study. Two thousand subscribers were selected at random from the sampling frame. A cover letter explaining the purpose of the study accompanied each survey. Three weeks following the initial mailing, a second letter was sent to those individuals who had not yet responded. This letter stressed the importance of their responses and gave them a number to call

if they had any questions or required a new copy of the survey.

3.4 Respondents

Of the 2,000 surveys mailed, 1,020 were completed and returned. Ninety-one were also returned as undeliverable yielding a response rate of 53.4%. In order to assess the possibility of non-response bias, a comparison of the responses of the early returns to those returned late was conducted (Armstrong and Overton 1977). A multivariate analysis of variance was conducted to determine whether differences in response time (early versus late) were associated with different responses. The test indicated no significant differences in any of the variables of interest (Wilks' Λ = 0.97; p = .735). Thus, non-response bias was not considered to be a problem.

The 1,020 respondents were mostly male (83%), and had an average age of forty-one years. They represented all levels of management and were evenly split between line and staff positions. They worked in a variety of functional areas including accounting and finance (18%), general management (30%), and marketing (16%); 43% had completed one college or university degree and a further 40% had completed post graduate degrees. The respondents' educational backgrounds were in business (61%), arts (10%), and social science (5%), with 10% reporting their educational background as other.

4. RESULTS

Data analysis was conducted using Partial Least Squares (PLS), a relatively new, extremely powerful multivariate analysis technique that is ideal for testing structural models with latent variables (see Wold [1985] for a comprehensive description). PLS analysis involves two stages: (a) assessment of the measurement model, including the reliability and discriminant validity of the measures, and (b) assessment of the structural model.

Prior to analysis, a holdback sample was removed from the data to permit testing of any model revisions. Revisions to the model were made as indicated by the data from the first subsample. The revised model was then analyzed using the holdback sample.

4.1 Initial Model

The item loadings and internal consistency reliabilities for the initial model were examined as a test of reliability. Discriminant validity was assessed using two methods. First the item loadings were examined to ensure that no item loaded higher on another construct than it did on the construct it was intended to measure. Second, the average variance shared between the constructs and their measures were compared to the variances shared between the constructs themselves. Table 1 displays internal consistencies and discriminant validity coefficients.

The measures of four constructs (support, self-efficacy, affect, and use) satisfied the criteria for reliability and discriminant validity in the initial model. Thus, no changes to these constructs were indicated. The remaining constructs evidenced some measurement problems. These problems, and the associated revisions, are discussed below.

Encouragement by Others. Three items in the encouragement of use construct did not correlate highly with the other measures. Encouragement of use from family, friends and subordinates did not appear to correlate highly with encouragement of use from peers and managers. Thus, these three items were dropped from the model in subsequent tests.

Others' Use. A similar problem was encountered in the measures of actual use by others. Actual use by family, friends and subordinates did not load highly on the construct. Moreover, actual use by subordinates loaded more highly on the encouragement by others construct than the others' use construct. Thus, as with the encouragement construct, these items were dropped from the subsequent analyses.

Outcome Expectations. Examination of the loadings for the outcome expectations construct indicated the possibility of multiple underlying dimensions for this construct. Reconsideration of the items confirmed this hypothesis. Two distinct dimensions appeared to be represented in the scale, corresponding to the job-related and other, more personal, outcomes of computer use. Job-related outcomes included items such as "If I use a computer, I will increase the quality of output of my job," while the personal outcomes included "If I use a computer, I will increase my sense of accomplishment." For the revised model, the outcome expectations construct was split into these two dimensions.

Anxiety. The individual item loadings for this construct were poor, indicating a problem in the measurement of anxiety. Reexamination of the measure and exploratory factor analysis revealed a number of underlying dimensions. These dimensions reflected, in addition to anxiety, a desire to learn more about computers, beliefs about learning to use computers, and beliefs about the appropriateness of computers in business and education. Ultimately, four items were selected from the scale to reflect anxiety. These items were chosen because they

Table 1. Reliability and Discriminant Validity Coefficients — Initial Model

CONSTRUCT	ICR†	1.	2.	3.	4.	5.	6.	7.	8.
1. Encouragement	0.85	0.67							
2. Others' Use	0.76	0.55	0.60						
3. Support	0.92	0.24	0.15	0.80					
4. Self-efficacy	0.95	0.14	0.19	-0.09	0.80				
5. Outcome Exp.	0.86	0.29	0.27	-0.10	0.33	0.61			
6. Affect	0.87	0.25	0.26	-0.09	0.52	0.49	0.77		
7. Anxiety	0.83	-0.24	-0.24	0.03	-0.59	-0.40	-0.71	0.49	
8. Use	0.81	0.22	0.29	-0.06	0.46	0.44	0.52	-0.47	0.72

† Internal Consistency Reliability

** Diagonal elements are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

seemed to best capture the feelings of anxiety associated with computer use.

4.2 Revised Model

The model revisions were made as indicated by the data and the resulting model (Figure 3) was tested using the holdback sample. The measurement statistics were substantially improved from the first model (Reliability and Discriminant Validity coefficients are reported in Table 2), indicating that the revisions to the measures achieved the desired effects.

Once the measurement model was considered acceptable, the path coefficients were assessed. All but one of the paths were statistically significant. However, three of the paths were in the opposite direction from that predicted by the model. Contrary to the hypotheses, support was negatively related to self-efficacy (H5) and to both performance-related (H6a) and personal outcome expectations (H6b).

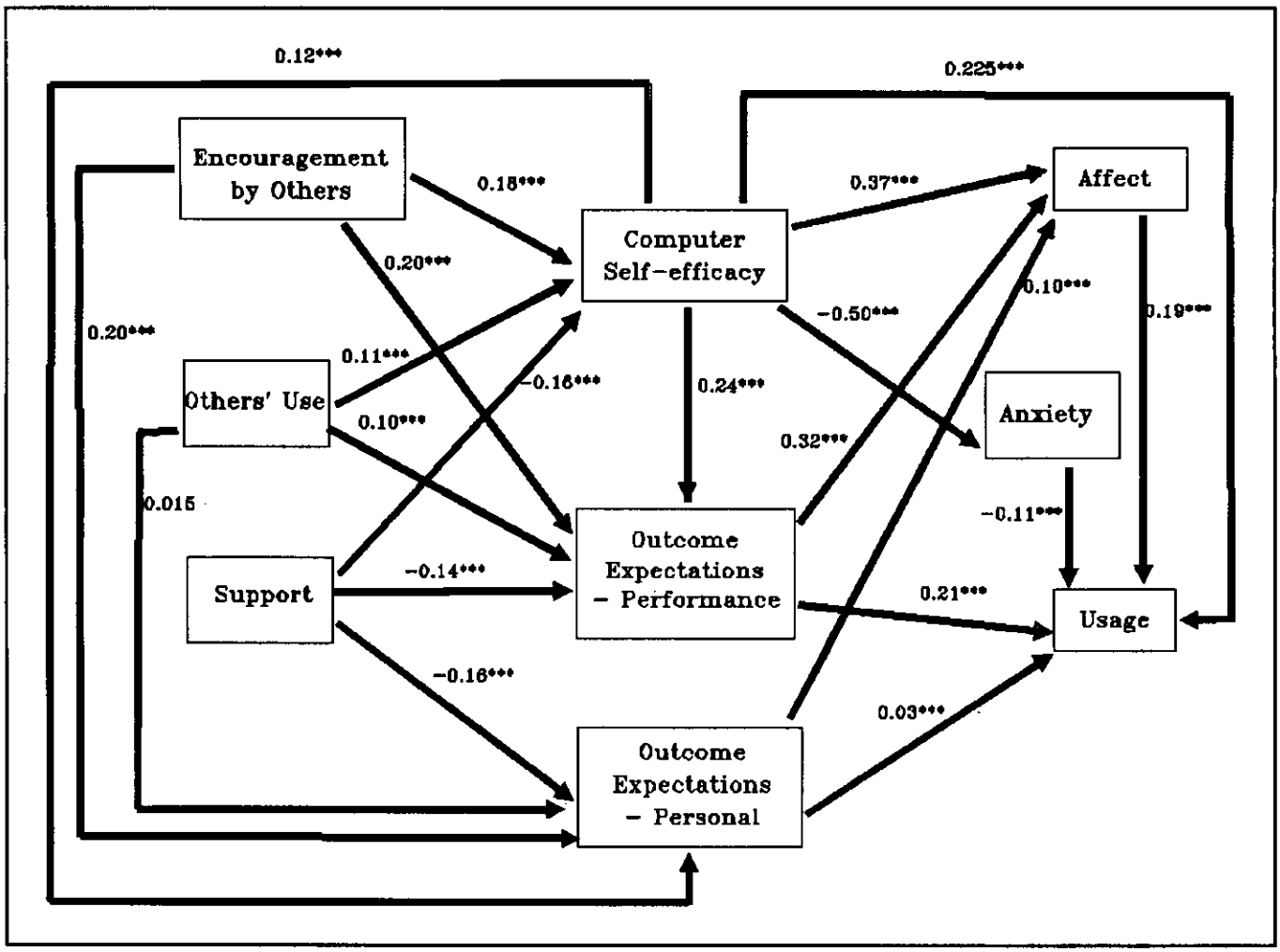
The substantive significance of the relationships must also be considered in the assessment of the model. The path coefficients in the PLS model represent standardized regression coefficients. Pedhazur (1982) suggests 0.05 as the lower limit of substantive significance for regression coefficients. As more conservative position, path coefficients of 0.10 and above are preferable. Thus, the path from Personal Outcome Expectations to Usage (β=0.03) is not considered substantively significant.

The path coefficients represent the direct effects of each of the antecedent constructs. It is also important to consider the total effects. In particular, performance-related outcome expectations and self-efficacy have roughly equal direct effects on use. However, when the total effects are considered, self-efficacy emerges as a more powerful predictor (total effect = 0.423 versus 0.269 for outcome expectations).

In total, the model explained 37% of the variance in affect, 25% of the variance in anxiety and 32% of the variance in use. In addition, 7% of the variance in self-efficacy, 17% of the variance in performance-related outcome expectations and 8% of the variance in other outcome expectations was explained. Thus, in terms of explanatory power, the model was acceptable.

4.3 Supplemental Analysis

One concern with the use of PLS to test this theory was the nature of the relationships tested. The model tested in this context was additive. That is, self-efficacy and outcome expectations were viewed as contributing in a linear additive manner to affect and behavior. This



*** p < 0.001

Figure 3. Revised Model and Path Coefficients

conception of the relationship is common in other research on Social Cognitive Theory (e.g., Frayne and Latham 1987). However, Bandura (1982) suggested that self-efficacy and outcome expectations have an interactive effect on use. He presented a 2x2 matrix of efficacy and outcome expectations and suggested that different behavioral and affective results were associated with each of the cells.

In order to test this proposition, a multivariate analysis of variance was conducted. The self-efficacy and outcome expectations scores were divided into high and low groups. These groups were used to construct a factorial MANOVA with affect and use as the dependent variables. Self-efficacy, performance related outcomes and other outcome expectations all showed significant positive main effects (p=.000). However, not one of the interactions was significant, suggesting that the linear additive model was sufficient to understand the influence of self-efficacy and outcome expectations.

5. DISCUSSION

The results of the present study provide support for the Social Cognitive Theory perspective on computing behavior. Outcome expectations, in particular those relating to job performance, were found to have a significant impact on affect and computer use. Affect and anxiety also had a significant, though somewhat small, impact on computer use. In addition, this research demonstrates that self-efficacy also plays an important role in shaping individuals' feelings and behaviors. Individuals with high self-efficacy use computers more, derive more enjoyment from their use of computers, and experience less computer anxiety.

Table 2. Reliability and Discriminant Validity Coefficients — Revised Model

CONSTR-UCT	ICR†	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Encouragement	0.87	0.80								
2. Others' Use	0.80	0.52	0.72							
3. Support	0.91	0.24	0.18	0.79						
4. Self-efficacy	0.95	0.20	0.18	-0.10	0.81					
5. Outcome Exp. - Performance	0.87	0.27	0.22	-0.09	0.32	0.72				
6. Outcome Exp. - Other	0.87	0.19	0.11	-0.12	0.17	0.49	0.76			
6. Affect	0.87	0.20	0.15	-0.13	0.49	0.48	0.32	0.75		
7. Anxiety	0.87	-0.11	-0.07	-0.00	-0.50	-0.23	-0.05	-0.51	0.79	
8. Use	0.82	0.17	0.24	-0.05	0.45	0.41	0.24	0.47	-0.37	0.73

† Internal Consistency Reliability

** Diagonal elements are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

These findings must be considered in light of the study's limitations, in particular the use of cross-sectional, survey data. Social Cognitive Theory predicts causal relationships between the constructs studied. PLS analysis provides strong support for this interpretation relative to other techniques such as correlation and regression, since all of the relationships (including those in the measurement model as well as in the structural model) are tested simultaneously. However, conclusive statements about causality cannot be made, since alternative explanations cannot be ruled out. Moreover, Social Cognitive Theory is based on a continuous reciprocal interaction among the factors studied. Feedback mechanisms could not be modeled with the present data, and thus the model tested is incomplete. Further research, in particular experimental and longitudinal studies, are clearly needed to address these issues.

A second limitation is the low variance explained in the self-efficacy and outcome expectations constructs. The three antecedent constructs (encouragement of use, others' use, and support) did not adequately explain variations in self-efficacy or outcome expectations. This finding can be better understood in the broader context of the formation of efficacy and outcome expectations. Self-efficacy and outcome expectations are formed on the basis of three sources of information. Actual experience with the behavior is the strongest source of efficacy information. However, due to the cross-sectional nature of the study, and the inherent difficulty of separating past from current experience, this variable was not incorporated into the research model. Observing others' behavior and its consequences is also a means of developing self-efficacy and outcome expectations. This source of influence was captured in this study by the measure of others' use of computers. However, the consequences of others' use was not represented in this measure and thus the correlation with self-efficacy and outcome expectations is somewhat low. The third source of information is verbal persuasion, or the encouragement of use by others. This concept incorporates both the nature (e.g., credibility) and degree of this persuasion,

but again, the measure incorporated only the degree of persuasion. A fourth source of efficacy information has also been proposed by Bandura (1986). Feelings of stress or anxiety may be interpreted by individuals to reflect a lack of competence, thus causing a lowering of self-efficacy. In the context of the research model, this would be represented by a reciprocal path from anxiety to self-efficacy. However, this relationship was not tested due to the absence of longitudinal data. Overall, then, the antecedents of self-efficacy and outcome expectations were incompletely measured in the present study, and resulting in relatively low explained variance.

In spite of the above noted limitations, these findings demonstrate the value of Bandura's theory. IS research to date has generally not considered how individuals' expectations of their capabilities influence their behavior, and thus paints an incomplete picture. It suggests that individuals will use computing technology if they believe it will have positive outcomes. Social Cognitive Theory, on the other hand, acknowledges that beliefs about outcomes may not be sufficient to influence behavior if individuals doubt their capabilities to successfully use the technologies. Thus, the Social Cognitive Theory perspective suggests that an understanding of both self-efficacy and outcome expectations is necessary to understand computing behavior.

The analysis also sheds light on the mediating role of self-efficacy and outcome expectations in the processing of environmental information. Several studies have demonstrated the influence of encouragement of use on computing behavior (e.g., Higgins, Howell and Compeau 1990; Pavri 1988). This study is consistent with those findings, but also suggests the mechanisms through which encouragement by others operates. Previous research posited a direct relationship between encouragement and use. This research suggests that encouragement influences behavior indirectly, through its influence on self-efficacy and outcome expectations. Similarly, others' actual use of computers influences behavior through its influence on self-efficacy and outcome expectations.

A surprising, and somewhat puzzling, finding was the negative influence of support on self-efficacy and outcome expectations. From a theoretical perspective, it seemed logical to hypothesize that higher organizational support would result in higher judgements of self-efficacy on the part of individuals, because they would have more resources to help them become more proficient. Moreover, support was believed to be an indication of organizational norms regarding use, and would thus positively influence outcome expectations in addition to self-efficacy. However, the data analysis suggested a negative relationship.

The reasons for these findings are not entirely clear, but several possibilities exist. With respect to self-efficacy in particular, it may be that individuals with lower self-efficacy are more aware of the existence of support within their organizations than those with high self-efficacy, because they make more use of those systems. Alternatively, the presence of high support may in some ways actually hinder the formation of high self-efficacy judgements. If an individual can always call someone to help them when they encounter difficulties, they may never be forced to sort things out for themselves, and thus may continue to believe themselves incapable of doing so. These alternative explanations have very different implications for organizations, and the data provide no indication as to which might be correct. Thus, additional research is needed to investigate this finding.

In conclusion, the present study provides support for a new perspective on individual reactions to computing technologies. This perspective, embodied in Bandura's Social Cognitive Theory and tested here on a sample of 940 Canadian knowledge workers, confirms much of the existing perspective about individuals' reactions. On the other hand, it also suggests an area where the current perspective is lacking in terms of the recognition of self-efficacy as a powerful force which must also be considered. Thus, while the Social Cognitive Theory perspective is unlikely to revolutionize our understanding of individuals' reactions to technology, it provides the foundation for a more complete and accurate understanding of these responses.

6. REFERENCES

Armstrong, J. S., and Overton, T. S. "Estimating Nonresponse Bias in Mail Surveys." *Journal of Marketing Research*, Volume 14, 1977, pp. 396-402.

Bandura, A. "Influence of Models' Reinforcement Contingencies on the Acquisition of Imitative Responses." In A. Bandura (Ed.), *Psychological Modeling: Conflicting Theories*, Chicago: Aldine/Atherton, 1971, pp. 112-127.

Bandura, A. "Self-efficacy: Toward a Unifying Theory of Behavioral Change." *Psychological Review*, Volume 84, Number 2, 1977, pp. 191-215.

Bandura, A. "Reflections on Self-efficacy." *Advances in Behavioral Research and Therapy*, Volume 1, 1978, pp. 237-269.

Bandura, A. "Self-efficacy Mechanism in Human Agency." *American Psychologist*, Volume 37, Number 2, 1982, pp. 122-147.

Bandura, A. *Social Foundations of Thought and Action*, Englewood Cliffs, New Jersey: Prentice-Hall, 1986.

Bandura, A.; Adams, N. E.; and Beyer, J. "Cognitive Processes Mediating Behavioral Change." *Journal of Personality and Social Psychology*, Volume 35, Number 3, 1977, pp. 125-139.

Betz, N.E., and Hackett, G. "The Relationships of Career-related Self-efficacy Expectations to Perceived Career Options in College Women and Men." *Journal of Counseling Psychology*, Volume 28, 1981, pp. 399-410.

Burkhardt, M. E., and Brass, D. J. "Changing Patterns or Patterns of Change: The Effects of a Change in Technology on Social Network Structure and Power." *Administrative Science Quarterly*, Volume 35, 1990, pp. 104-127.

Compeau, D. R., and Higgins, C. A. "The Development of a Measure of Computer Self-efficacy." Paper presented at The Administrative Science Association of Canada, Niagara Falls, ON, May 30-June 1, 1991.

Davis, F. D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." *MIS Quarterly*, Volume 13, Number 3, 1989, pp. 319-340.

Davis, F. D.; Bagozzi, R. P.; and Warshaw, P. R. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models." *Management Science*, Volume 35, Number 8, 1989, pp. 982-1003.

Davis, T. R. V., and Luthans, F. "A Social Learning Approach to Organizational Behavior." *Academy of Management Review*, Volume 5, 1980, pp. 281-290.

DeSanctis, G. "Expectancy Theory as an Explanation of Voluntary Use of a Decision Support System. *Psychological Reports*, Volume 52, 1983, pp. 247-260.

Engle, J. F.; Blackwell, R. D.; and Miniard, P. W. *Consumer Behavior* (Fifth Edition). New York: Holt, Rinehart and Winston, 1986.

Fornell, C. "A Second Generation of Multivariate Analysis: Classification of Methods and Implications for Marketing Research." Working Paper, Ann Arbor, Michigan: The University of Michigan, 1984.

Frayne, C. A., and Latham, G. P. "The Application of Social Learning Theory to Employee Self-management of Attendance." *Journal of Applied Psychology*, Volume 72, 1987, pp. 387-92.

Gist, M. E.; Schwoerer, C. E.; and Rosen, B. "Effects of Alternative Training Methods on Self-efficacy and Performance in Computer Software Training." *Journal of Applied Psychology*, Volume 74, 1989, pp. 884-891.

Heinssen, R. K.; Glass, C. R.; and Knight, L. A. "Assessing Computer Anxiety: Development and Validation of the Computer Anxiety Rating Scale." *Computers and Human Behavior*, Volume 3, 1987, pp. 49-59.

Higgins, C. A.; Howell, J. M.; and Compeau, D. R. "An Empirical Test of Bandura's Model of Innovation Adoption." Paper presented at a workshop of the Diffusion Interest Group on Information Technology, Copenhagen, Denmark, December 16, 1990.

Hill, T.; Smith, N. D.; and Mann, M. F. "Communicating Innovations: Convincing Computer Phobics to Adopt Innovative Technologies." In R. J. Lutz (Ed.), *Advances in Consumer Research*, Provo, Utah: Association for Consumer Research, Volume 13, 1986, pp. 419-422.

Hill, T.; Smith, N. D.; and Mann, M. F. "Role of Efficacy Expectations in Predicting the Decision to Use Advanced Technologies: The Case of Computers." *Journal of Applied Psychology*, Volume 72, Number 2, 1987, pp. 307-313.

Igbaria, M.; Pavri, F. N.; and Huff, S. L. "Microcomputer Applications: An Empirical Look at Usage. *Information and Management*, Volume 16, 1989, pp. 187-196.

Latham, G. P., and Saari, L. M. "Application of Social Learning Theory to Training Supervisors Through Behavioral Modeling. *Journal of Applied Psychology*, Volume 64, Number 3, 1979, pp. 239-246.

Lohmöller, J. B. "The PLS Program System: Latent Variables Path Analysis with Partial Least Squares Estimation." *Multivariate Behavioral Research*, Volume 23, 1988, pp. 125-127.

Loyd, B. H., and Gressard, C. "Reliability and Factorial Validity of Computer Attitude Scales." *Educational and Psychological Measurement*, 1984, pp. 501-505.

Manz, C. C., and Sims. H. P. "Beyond Imitation: Complex Behavioral and Affective Linkages Resulting from Exposure to Leadership Training Models." *Journal of Applied Psychology*, Volume 71, 1986, pp. 571-578.

Pavri, F. N. *A Study of the Factors Contributing to Microcomputer Usage*, Unpublished doctoral dissertation, The University of Western Ontario, London, 1988.

Pedhazur, E. J. *Multiple Regression in Behavioral Research*, New York: Holt, Rinehart and Winston Inc., 1982.

Robey, D. "User Attitudes and Management Information System Use." *Academy of Management Journal*, Volume 22, Number 3, 1979, pp. 527-538.

Schunk, D. H. "Modeling and Attributional Effects on Children's Achievement: A Self-efficacy Analysis." *Journal of Educational Psychology*, Volume 73, 1981, pp. 93-105.

Stumpf, S. A.; Brief, A. P.; and Hartman, K. "Self-efficacy Expectations and Coping with Career-related Events." *Journal of Vocational Behavior*, Volume 31, 1987, pp. 91-108.

Thompson, R. L.; Higgins. C. A.; and Howell, J. M. "Personal Computing: Toward a Conceptual Model of Utilization." *MIS Quarterly*, Volume 15, Number 1, 1991, pp. 125-143.

Triandis, H. C. "Values, Attitudes, and Interpersonal Behavior." *Nebraska Symposium on Motivation, 1979: Beliefs, Attitudes and Values*. Lincoln, Nebraska: University of Nebraska Press, 1980.

Webster, J.; Heian, J. B.; and Michelman, J. E. "Mitigating the effects of computer anxiety through training." In J. I. DeGross, M. Alavi, and H. Oppelland (Eds.) *Proceedings of the Eleventh International Conference on Information Systems*, Copenhagen, Denmark, 1990, pp. 171-182.

Webster, J., and Martocchio, J. J. "Turning Work into a Game: Implications for Microcomputer Software Training." Under review, 1990.

Wold, H. "Systems Analysis by Partial Least Squares." In P. Nijkamp, H. Leitner, and N. Wrigley (Eds.), *Measuring the Unmeasurable*, Boston: Martinus Nijhoff Publishers, 1985.